

Abstract #265770

DIAGENETIC CRYSTAL GROWTH IN THE MURRAY FORMATION, GALE CRATER, MARS

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The Pahrump region (Gale Crater, Mars) marks a critical transition between sedimentary environments dominated by alluvial-to-fluvial materials associated with the Gale crater rim, and depositional environments fundamentally linked to the crater's central mound, Mount Sharp. At Pahrump, the Murray formation consists of an approximately 14-meter thick succession dominated by massive to finely laminated mudstone with occasional interbeds of cross-bedded sandstone, and is best interpreted as a dominantly lacustrine environment containing tongues of prograding fluvial material. Murray formation mudstones contain abundant evidence for early diagenetic mineral precipitation and its subsequent removal by later diagenetic processes.

Lenticular mineral growth is particularly common within lacustrine mudstone deposits at the Pahrump locality. High-resolution MAHLI images taken by the Curiosity rover permit detailed morphological and spatial analysis of these features. Millimeter-scale lenticular features occur in massive to well-laminated mudstone lithologies and are interpreted as pseudomorphs after calcium sulfate. The distribution and orientation of lenticular features suggests deposition at or near the sediment-water (or sediment-air) interface. Retention of chemical signals similar to host rock suggests that original precipitation was likely poikilotopic, incorporating substantial amounts of the primary matrix. Although poikilotopic crystal growth is common in burial environments, it also occurs during early diagenetic crystal growth within unlithified sediment where high rates of crystal growth are common. Loss of original calcium sulfate mineralogy suggests dissolution by mildly acidic, later-diagenetic fluids. As with lenticular voids observed at Meridiani by the Opportunity Rover, these features indicate that calcium sulfate deposition may have been widespread on early Mars; dissolution of depositional and early diagenetic minerals is a likely source for both calcium and sulfate ion-enrichment in burial fluids that precipitated in ubiquitous late-stage hydrofracture veins.

Abstract ID#:

265770

Password:

115895

Meeting:

2015 GSA Annual Meeting in Baltimore, Maryland, USA (1-4 November 2015)

Session Type:

Topical Session

Primary Selection:

T132. Mineralogy of Diagenesis on Earth and Mars: In Honor of Nicholas J. Tosca, 2015 MSA Awardee

Abstract Title:

DIAGENETIC CRYSTAL GROWTH IN THE MURRAY FORMATION, GALE CRATER, MARS

Preferred Presentation Format:

Oral

Discipline Categories:

Planetary Geology

Abstract Submission Fee:

Paid (gsa-2015AM-0885-8615-8915-5240)

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